

*Current Avionics Harmonization
Activities
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Discussion Items

- ▶ Harmonization
- ▶ Flight Guidance Systems
- ▶ Cat 1/II Operations
- ▶ Cat III Autoland Operations
- ▶ Compass Systems
- ▶ Instrument Systems
- ▶ AC/AMJ 25-11 & AMJ 1322

Harmonization

- ▶ ARAC
- ▶ TAEIG
- ▶ FAST TRACK PROCESS

The Harmonization Process

- ▶ The HWG completes a Terms of Reference for approval by TAEIG
- ▶ The TOR describes the basic activities and issues that the group is considering
- ▶ The HWG does the required work on the relevant JAR/FAR rules and AC/ACJ's
- ▶ The HWG completes the 19 point questionnaire

The 19 Point Questionnaire

- ▶ What is the underlying safety issue addressed by FAR/JAR?
- ▶ What are the current FAR and JAR standards?
- ▶ What are the differences in the standards?
- ▶ What, if any, are the differences in required means of compliance?
- ▶ What is the proposed action?
- ▶ What should the harmonized standard be?

Questions

- ▶ How does this proposed standard address the underlying safety issue?
- ▶ Relative to current FAR, does the proposed standard increase, decrease, or maintain the same level of safety?
- ▶ What other options have been considered and why were they not selected?
- ▶ Who would be affected by the proposed change?
- ▶ To ensure harmonization, what current advisory material need to be included in the rule text or preamble?

questions

- ▶ Is existing FAA advisory material adequate?
- ▶ If not, what advisory material should be adopted?
- ▶ How does the proposed standard affect the current ICAO standard?
- ▶ How does the proposed standard affect other HWG's?
- ▶ What is the cost impact of complying with the proposed standard?
- ▶ Does the HWG want to review the draft NPRM at phase 4 prior to publication in the FR?
- ▶ Is the "fast track" process appropriate?

FLIGHT GUIDANCE SYSTEMS

- ▶ **TASK: HARMONIZE FAR/JAR 25.1329 AND AC/ACJ 25.1329**
- ▶ **CURRENTLY AT VERSION 8**
- ▶ **JAR 25.1329 USED AS BASELINE**

THE PROPOSED RULE

- ▶ Quick disengagement controls for the autopilot and autothrust systems must be provided for each pilot
- ▶ Failure of the FGS to disengage must be evaluated IAW FAR 25.13
- ▶ The engagement or switching of the FGS must not cause a significant transient
- ▶ A normal disengagement of the FGS must not cause a significant transient
- ▶ Under abnormal conditions, disengagement of the FGS shall not require exceptional piloting strength skill requirements of § 25.1309.

The Proposed Rule

- ▶ Command reference controls must operate in the plane and sense of motion specified in FAR 25.777(b) and FAR 25.779(a) for cockpit controls
- ▶ The FGS shall not produce hazardous loads on the airplane, or hazardous deviations in the flight path during normal operations or during malfunctions

The Proposed Rule

- ▶ The FGS shall maintain the airplane within reasonable bounds of the normal flight envelope
- ▶ The armed and active modes of the FGS must be presented to the flight crew
- ▶ A unique visual and aural warning must be provided for autopilot disengagements
- ▶ A positive indication must be provided for autothrust disengagements

Autopilot Engagement/Disengagement

- ▶ General: Consistent with flight crew tasks and procedures & not require undue attention
- ▶ Quick Disengagement Control: Accessible and operable from a hands on position
 - With one hand on the control wheel or equivalent
 - Easily located by the pilot under all lighting conditions
 - Should not cause an input to the flight controls
 - Designed to minimize inadvertent operation

*Alternate Means of Autopilot
Disengagement*

- If required by 25.1309 consider:
 - Independence
 - Is it readily accessible to each pilot
 - Latent failures/reliability
- Acceptable means of compliance include:
 - Selecting engagement control to “OFF”
 - Use of a secondary disengagement control

*Flight Crew Override of the
Autopilot*

- The autopilot “should” disengage when the flight crew applies a significant override force to the controls
- “Unless” a safe alternative can be demonstrated.
- Should not disengage for minor bumps
- A small sustained application of force should be safe

Flight Crew Trim Inputs

- ▶ If the pilot applies direct pitch trim inputs, the autopilot should disengage or
- ▶ The pitch trim inputs applied by the pilot should be inhibited

Flight Director Engagement

- ▶ A means should be provided for each pilot to select the flight director for display
- ▶ Switch position alone is not sufficient
- ▶ The display of guidance cues is sufficient
- ▶ With multiple FD, with 1 FD active, the 2nd should engage into the armed & active modes
- ▶ Guidance Cues: Should be removed when valid guidance is not available
- ▶ Automatic: Applicable to Windshear Guidance

Flight Director Disengagement

- A means should be provided for each pilot to deselect their on-side Flight Director
- A positive indication should be provided
- Switch position is not sufficient

Autothrust Engagement

- The engagement controls should be accessible to each pilot
- Engagement outside the NFE should be analyzed
- Positive indications should be provided
- Inadvertent activation on the ground should be prevented
- Automatic engagement should be obvious and safe

Autothrust Disengagement

- ▶ Design to prevent inadvertent disengagement; especially during GA
- ▶ Should not cause any unsafe condition
- ▶ Should be positively indicated
- ▶ Visual indications are required
- ▶ Aural alerts are encouraged
- ▶ Quick Disengagement Controls must be provided for each pilot on the thrust control

Pilot Override of Autothrust Control

- ▶ It should be possible for the pilot to readily override the autothrust function by moving the thrust levers with one hand
- ▶ The autothrust may remain engaged during pilot intervention
- ▶ The autothrust may also disengage as a result of pilot intervention

*FGS Mode
Selection/Annunciation*

- The FD should engage in the same mode as the AP and vice versa (Mode Compatibility)
- Mode Annunciation should convey:
 - Armed and Active Modes
 - What it will be doing
 - What it is doing
 - Target Information: speed, heading, altitude
- Primary field of view; e.g. PFD

FGS Alerting

- FGS Alerting should follow the provisions of 25.1322
- An aural alert and visual caution should be provided for conditions that:
 - Could make continued autopilot operation unsafe
 - Would require exceptional pilot skill or alertness following autopilot disengagement
 - Special considerations for envelope limiting

FGS Alerting Considerations

- ▶ Limits of autopilot control authority
- ▶ Excessive longitudinal out-of-trim
- ▶ Excessive trim rates
- ▶ Excessively high or low airspeeds
- ▶ Excessive pitch and bank angles
- ▶ Lateral out-of-trim conditions

HUD Considerations

- ▶ Head Up/Head Down Compatibility
 - Same information on both displays have the same meaning
 - Display formats and data sources need to be compatible
 - BUT, the display presentations need not be identical
 - Basic T concepts remain essentially the same
- ▶ Equivalent Alerting Functionality

Normal Performance

- The applicant should specify and demonstrate the minimum performance for each FGS mode, for its intended use during routine operations
- How good? At least as good as a pilot
 - RVSM?
 - RNP?
 - CAT I/II/III?

Rare Normal Performance

- The FGS must be safe and predictable both within and for momentary excursions outside the normal flight envelope
- Rare normal conditions are:
 - Significant winds, windshears, gusts
 - Moderate or greater turbulence
 - Severe or unusual types/effects of icing

Non-Normal Performance

- Characteristics outside the normal flight envelope should be assessed (if applicable)
- Non-Normal includes:
 - Engine failures
 - Systems failures
 - Non-standard configurations
 - Operation outside the normal flight envelope

Characteristics of Specific Modes

- Lateral Modes
 - Heading/Track Hold
 - Heading/Track Select
 - LNAV

Vertical Modes

- ▶ Vertical Speed
- ▶ Flight Path Angle
- ▶ Airspeed Hold
- ▶ Airspeed Select
- ▶ Flight Level Change
- ▶ Altitude Capture
- ▶ Altitude Hold
- ▶ VNAV

Multi-Axis Modes

- ▶ Takeoff Mode
- ▶ Go-Around Mode
- ▶ Approach Mode

Autothrust Modes

- Thrust Modes
 - N1
 - TO-1
 - Flex
 - Climb, Cruise, MCT
 - Idle
- Speed Modes

Envelope Protection

- Concept applicable to high and low speed protection
- Maintaining the airplane with the normal flight envelope
- Reverting to a speed mode when thrust is insufficient to maintain the requested path

Safety Assessment

- ▶ 25.1309 is the basis for analysis
- ▶ FGS Failure Conditions include:
 - Control of the pitch, roll and yaw axes
 - Control of thrust
 - Integrity and availability of guidance
 - Structural integrity
 - Flightcrew performance and workload
 - Safety of occupants

CATEGORY I/II OPERATIONS

- ▶ AC 120-29A DATED TBD
- ▶ 2.5 YEARS OF EFFORT
- ▶ NOT WELL COORDINATED
- ▶ DISAPPROVED AT SEVERAL LEVELS
- ▶ RESOLUTION VIA THE ARAC
PROCESS

DISCUSSION

- ▶ BODY OF THE DOCUMENT IS COMPLEX
- ▶ NUMEROUS INCONSISTENCIES WITH CURRENT POLICY
- ▶ RULE-MAKING BY AC
- ▶ SELF-REGULATION BY CARRIERS

CATEGORY III OPERATIONS

- ▶ SPECIFIED IN AC 120-28D
- ▶ SCOPE OF THE DOCUMENT
- ▶ OPERATIONAL ASPECTS
- ▶ AIRWORTHINESS APPENDICES
- ▶ SIGNIFICANT CHANGES FROM AC 120-28C

SCOPE OF AC 120-28D

- ▶ RNP
- ▶ HUD'S
- ▶ CAT IIIA
- ▶ CAT IIIB
- ▶ GLS (DGPS/LAAS)

Autoland Operations

- ▶ Fail Passive Concepts
- ▶ Fail Operational Concepts
- ▶ Alert Height Concept

FAR/JAR 25.1328
DIRECTION INDICATOR

- ▶ There was no FAR equivalent.
- ▶ Assures that instruments that display direction information adequate for safe operation
- ▶ Current ACJ limits the error to 1 degree except short range airplanes can exceed the limit

FAR 25.1327
Magnetic Direction Indicators

- ▶ What kind?
- ▶ Stabilized or Non-Stabilized?
- ▶ The requirement is 10 degree accuracy so non-stabilized is inferred.
- ▶ The JAR 25.1327 is specific
- ▶ We will harmonize on the JAR and provide a new AC based on the ACJ for 25.1328

FAR 25.1333
INSTRUMENT SYSTEMS

- Refers to instruments required by 25.1303(b)
- Refers to information essential to the safety of flight including attitude, altitude, airspeed and direction
- “one display” versus “sufficient information”
- “without immediate pilot action” versus “without additional pilot action”

AC/AMJ25.1322
FLIGHT CREW ALERTING

- Visual Alerts
 - Color of messages
 - Syntax of messages
- Aural Alerts
 - Distinctive sounds
 - Integration with other cockpit audio
 - Multiple alerts
 - Prioritization

Alerting Considerations

- ▶ Use of “Aircraft Alerting Systems Design Guidelines”, RD-81/38.11
- ▶ Inhibits, prioritization, attention-getting
- ▶ Acknowledgement and cancellation
- ▶ Rearming
- ▶ Location, Grouping
- ▶ Training, Test and Evaluation of Alerts
- ▶ Time critical/Warnings/Cautions/Advisories
- ▶ Operations/MEL